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AUTHOR	Koch, H. William; Grattidge, Walter
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ABSTRACT

Information analysis centers must perform the function of evaluation as well as compilation, in order to generate products and services with increased utility and user acceptance. Also, these centers must perform a dual role as wholesaler and retailer. These roles, as well as problems and examples of production and marketing experiences, are examined so as to elucidate the present and future potential of information analysis centers in improving communication among scientists. The full potential will be shown to require marketing by information analysis centers operated by a complete spectrum of institutions, including governmental agencies, scientific and technical societies, not-for-profit groups, and commercial firms. (Author)

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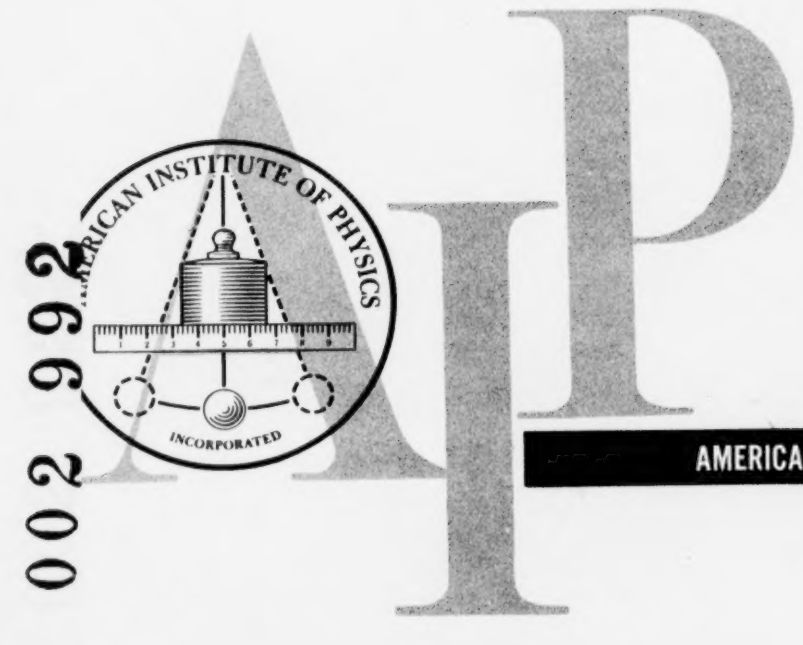
H. William Koch
American Institute of Physics

Walter Grattidge
General Electric Company



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MARKETING THE PRODUCTS AND SERVICES OF INFORMATION ANALYSIS CENTERS*

H. William Koch, American Institute of Physics
and
Walter Grattidge, General Electric Company

Abstract

Information analysis centers must perform the function of evaluation as well as compilation, in order to generate products and services with increased utility and user acceptance. Also, these centers must perform a dual role as wholesaler and retailer. These roles, as well as problems and examples of production and marketing experiences, are examined so as to elucidate the present and future potential of information analysis centers in improving communication among scientists. The full potential will be shown to require marketing by information analysis centers operated by a complete spectrum of institutions, including governmental agencies, scientific and technical societies, not-for-profit groups, and commercial firms.

Introduction

In 1963, the Weinberg Panel on Science Information [1], with great foresight, envisaged information centers that were technical institutes rather than technical libraries. Such centers would, with the aid of dedicated and knowledgeable interpreters, "collect relevant data, review a field, and distill information in a manner that goes to the heart of a technical situation," and thereby would be "more helpful to the overburdened specialist than is a mere pile of relevant documents." The panel projected that such information analysis centers would eventually become "the prime retailers of information to scientists." [2].

This ultimate potential is apparent from the present developments of several different types of information analysis centers based both on the nature of the particular information base being covered and on the requirements

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of the user group to which the output of a center is primarily directed. Garvin [3] has summarized the scopes of such centers. As he indicates, the important factor in the Information Analysis Center Concept is evaluation and those products that result from it.

Many centers, whose function is to process information already in the public domain, are now well established. Within the National Standard Reference Data System there are some 26 information analysis centers concerned with the review and evaluation of data in the physical sciences. In addition, there are almost a hundred other federally-supported analysis centers.

Simultaneously, there are developing within industry comparable operations devoted specifically to internal company users and with coverage of both public and proprietary data. In addition, there are commercial services, both traditional and new, available at both a "wholesaling" level and also at a direct user "retailing" level.

This report on the marketing of their products and services assumes as one of its basic premises the evaluation model of an information analysis center. Further, while the primary focus is on evaluated numerical data produced by the centers as distinct from documents, the latter type of product is important and will be referred to. In addition, since the user is the dominant factor, the production and marketing functions must be closely intertwined and directed to the ultimate user. Therefore, both production and marketing are considered in this report.

Starting from these premises, what are the production and marketing limitations and opportunities? How can we successfully market products and services that have predominant characteristics determined in the production phases of those products and services? How do we grapple with the vast producer-oriented stores of data being generated by scientists and technologists?

How can we best user-orient the data at information analysis centers? For that, in effect, is the next important phase between production and marketing that must be accomplished if we are to market the data. How do we work towards information analysis centers of the future as "prime retailers" to scientists?

Problems of Production and Marketing

a. Problems of Production

The production problems of data compilations and evaluation (see Table I) are understood and have, unfortunately in some instances, become an accepted unsolved tradition among research workers. These problems must now be tackled and research workers must be involved in their solution if research and development work is to be kept efficient and effective. Today's new solutions involve non-traditional along with traditional methods.

It has long been recognized that it is much easier to do a piece of research and report on it than it is to review the literature and data in a critical manner and produce an authoritative review or data compilation. Many research professors have graduate students who are given individual research assignments and from whom research results can be monitored and evaluated. In the case of an authoritative review or data compilation, it is usually necessary for the professor or senior researcher to remove himself from the research environment, with little or no support of assistants, and to examine the information in a scholarly manner. The professional rewards have traditionally been larger for the research professor discovering new concepts than they have been for the same individual reviewing, evaluating, and compiling the data of others.

Because reviews and compilations require special encouragement and support, the National Bureau of Standards established in 1963 a National

TABLE I

Problems in Production and Marketing

Problem Area	Problem	Solution
Production	Inadequate Professional Encouragement and Reward	1. NSRDS 2. Review and Compilation Fellowships
Publication	1. High Cost 2. No R & D Funds 3. No Involvement of Science Community	1. NSRDS 2. Proposed Journal of Chem. & Phys. Ref. Data
Technology	Uneconomic Computer Storage and Accessibility	Combination of Computer Tape and Microfilm Service
Marketing	Diversity of Products, Applications, Users	Successful Response to Marketing Challenge by Government, Society, Not-for-profit and Commercial Sectors

Standard Reference Data Program. By means of this program, it is possible to have manpower for data compilations fully supported with Federal funds in a manner that has become traditional in the support of original research work. To date, the program is still in its infancy. While the Federal Government is supplying funds of the order of $300 million for research in physics, the Standard Reference Data System (NSRDS) is only funding physics data compilations at an annual rate of less than $2.0 millions. It would appear that more support in the latter area would yield high leverage in increasing the productivity of the former investment.

While the Federal Government has recognized its responsibility to encourage reviews and compilations, various scientific societies are also recognizing their responsibilities in this direction. For this reason, the American Institute of Physics, in representing its seven member societies, plans to make a major "review and compilations" proposal to the National Science Foundation to obtain financial support. If this support is forthcoming, it is proposed that the U. S. physics community will be directly involved in providing fellowship funding to outstanding specialists so that these specialists can spend a sabbatical year at centers of their choosing to undertake specific review projects. Such centers will undoubtedly include many of the information analysis centers that are represented at this conference.

b. Problems of Publication

The second problem in numerical data compilations is their publication. By their very nature, reviews and compilations frequently result in articles that are longer in length and frequently more complicated and detailed than are the primary research articles. Extensive tables of data are frequently very difficult to have published because of the attitudes of publishers and because of the lack of funding of authors. The authors and their

institutions frequently have funds to publish the results of their research work, but do not have funds to publish the results of reviewing and compiling the data of others.

A further aspect of the problem of publishing data compilations has to do with the lack of involvement of the scientific community in the publication process. In the case of primary research articles, the scientific community has established a system of referees who review for acceptance, articles submitted for journal publication. In the case of data reviews, there is not as yet an accepted system for refereeing compilations and data values. This is because the compilations have not, in general, been published in the scientific literature operated by scientific societies. The result has been that the scientific community has not been involved in a formal way. Somehow peer acceptance and prestige needs to be developed by the scientific community to those who will analyze, review, and compile, and also those who referee the results prior to publication.

Most of the results of the NSRDS program to date have been published by the Government Printing Office, and their availability has been announced in media not generally available to members of the scientific community on an individual basis as are the primary research journals. An attempt to develop a solution for these publishing problems has been the recent proposal for joint sponsorship by the American Chemical Society, the American Institute of Physics, and the National Bureau of Standards, of a new journal, The Journal of Chemical and Physical Reference Data. This journal will be able to publish the reviews and compilations originating in the centers supported by NSRDS as readily as any research article. Under the proposal, the principal elements of the scientific community involved in the work of NSRDS will be intimately involved in reviewing, refereeing, and preparing data compila-

tions as they are in the same functions for primary research articles. The societies also would take care of publishing and marketing.

c. Problems of Technology

Another problem is the technological one of how to disseminate numerical data. The same determining factors involved in document handling and dissemination are involved in data handling and dissemination. In the case of documents, the full text of documents are not going to be disseminated in the form of a computer tape for a good many years to come. Similarly for data, although there are now some examples of data being available in tape form for analysis and evaluation by the users. An example of such data are the neutron data tapes being produced by the Brookhaven National Laboratory for use by reactor design groups. An interim compromise to disseminating the full text of documents on computer tape is the announced plan of the American Institute of Physics to produce a combination package of techniques. One part of the package will be a computer-searchable magnetic tape describing the complete bibliographical information about all the articles contained in full text on the second part--a microfilm tape issued every two weeks or every month, simultaneously with its computer tape counterpart index. As soon as The Journal of Chemical and Physical Reference Data has been placed in production, it will be available in this dual format.

d. Problems of Marketing

Government agencies, scientific and technical societies and not-for-profit groups, and firms in the commercial sector are all becoming involved in marketing information services and especially in marketing the specialized products of information centers. An understanding of the relationships of these different organizations and their respective types of marketing requires an awareness of what is encompassed in the new terms of wholesaling and

retailing now beginning to be applied to information services.

Wholesaling includes the production, evaluation, and marketing by and for the producing scientists as well as the serving of customers who in turn repackage or produce specialized information products for retailing to the ultimate user. Thus, if one is to have an economically stable industry, the criteria for determining economy, timeliness and quality at the retail level must reflect the equivalent criteria incurred in packaging and dissemination at the wholesale level. The extent to which wholesalers see their principal activity as information generation (through critical reviews and data evaluation) may determine the extent that they consider themselves participating in the primary research and development function. In the words of the Weinberg panel report, "Transfer of information is an inseparable part of research and development." However, transfer and dissemination without a contribution of evaluation does not appear to command a large value-added factor in the market place.

Marketing has to be done not only by wholesaling to the specialist groups who require specialized services by agencies and societies, but by retailing to non-specialist public audiences and to specialist audiences of other specialties. To date, customized public retailing has been done primarily by the commercial sector. This sector deserves to be encouraged and stimulated in continuing in these areas for which it has particular capabilities and expertise.

The major problem in marketing at both the wholesale and retail level results from the requirement to disseminate or deal with a wide diversity of data products, of access and application, and of secondary information generators and ultimate users. The dissemination, in turn, has to be done under conditions of economy, timeliness, and quality that are acceptable to the user.

The marketing challenge is therefore to identify and reach the group of potential users even when this group is of a narrow scientific or technical discipline. Specialized libraries and information centers are possible marketing contact points. However, as previously indicated, not all potential users are linked to identifiable specialized libraries. Particularly in relating to academic users, it may be necessary to use broad marketing channels, such as professional journal advertising and broad library mailings [4] to ensure coverage of that user segment. The efficiency of this notification process becomes a significant factor in the cost of marketing and must be seriously considered in establishing a pricing policy which reflects full cost recovery, at least of the secondary dissemination costs.

With this explanation of marketing and its major problem, let us consider other problems created by the acceptability criteria of economy, timeliness, and quality.

1. Criteria of Economy (or Costs and Prices)

There appears to be experience accumulating regarding what customers are willing, or perhaps better, are now conditioned to pay for information products and services.

Table II lists types of information services involved in the handling of data compilations by the commercial sector. There are different types of compilations available with varying degrees of evaluation involved in the production process. As shown in the final column, the attitude of the market at the present time is that the charges for providing such data services cannot be much above the distribution cost level. The experiences undoubtedly reflect the user's evaluation of the ease, ability and costs of reproducing the data himself compared to having the data supplied. If problems of

TABLE II

Data Compilation Products and Markets

Product Type	Principal Identifiable Market Segments	Contact Channels	Competitive Products	Market Attitude on Value
1. Unevaluated Data Compilations.	• Research Peer Group	• Profess. Soc. Memb. • Univ. Dept.	• Journals (Special Issues)	Users value the information only at the distribution cost level.
2. Evaluated Data Compilations.	• Research Peer Group • Industry Design Eng. • Education	• Profess. Soc. Memb. • Business (SIC Groups) • Univ. Depts. Libraries • Spec. Libraries	• Publishers Monographs • Material Suppliers Catalogues • Handbooks	Users appear to value the information at the distribution cost level plus a *small* return to the expert to partially cover his cost of commentary.
3. Combination Data with Expert Forecast (principally economic).	• Industry Business Planning Function	• Business (SIC Groups)	• Specialized Newsletters	As 2 above.
4. Engineering Design Data (usually proprietary).	• Industry Engineering Function	• In-House Distribution	• Usually Non-Marketable Due to Proprietary Content	Most buyers are suspicious of anyone offering this type of product.

acquiring the data by purchase are of a comparable order to reproducing the data, then the data will not be bought. If the research is Federally sponsored, then the threshold for the buy decision may be still lower. One may surmise that as the availability of sponsorship for research and development tightens, program managers will increasingly evaluate the full costs of data duplication and be prepared to buy when the data is available.

Since run-off and distribution costs appear to fix the level at which users consider it economic to buy compilations, how can pre-run costs be met? The whole question of cost recovery in the dissemination of scientific data has been the subject of a study of an ad hoc Panel on Marketing of the Numerical Data Advisory Board of the National Research Council--a study related specifically to the products of the National Standard Reference Data System. In a memorandum by the Panel transmitted to the Director of the National Bureau of Standards, the following two recommendations were made:

> "1. The Panel recommends that the scientists engaged in the important and necessary work of data evaluation should be supported by the Government, in similar manner to the Government's position in funding primary R & D scientists; this work should not be a target for cost recovery.
>
> "2. The Panel recommends that the accepted page charge concept for R & D results be applied to the publication of NSRDS products as well. In practice, some (if not all) of the pre-run costs of publication of data compilations should be considered for Federal support."

These recommendations are consistent with the concept that publication is a necessary part of research as well as its compilation and evaluation; and that users can be expected to pay for data compilations at a rate that covers run-off, distribution, and very little, if any, of the pre-run cost for evaluation.

2. Criteria of Timeliness and Quality

Just as with costs, the criteria on what the specialist, as well as the non-specialist, will be willing to afford in time delays and in quality are determined, primarily, in subtle ways at the input by production standards and criteria. A prize example in the present context is the extensive growth during the 1960's in the use of preprints and governmental reports that competed with the more conventional information transfer mechanisms available in the primary research journals. These

journals have been, and will continue to be, produced by both society and commercial publishers. As the journals have gotten bigger, more costly, and more delayed, other communication mechanisms, such as the preprints and reports, were invented to bypass the problems of the journals.

It has become recognized that preprints and reports are very effective ways of communicating quickly to a specialized audience. However, these mechanisms are extremely costly and are, in general, non-public communication mechanisms. There have been concerns expressed that these mechanisms have been getting out of control, and will result in the disappearance of journals in their present form. However, the multiple advantages of journals and the increased attention to costs and timeliness are resulting in renewed recognition that the conventional, proven techniques in the form of journals must be strengthened in order to accomplish wide, public, and economic dissemination of scientific information.

Examples of User-Oriented Data Products and Services and Their Marketing

a. Handbooks

The conventional method of bringing comprehensive data compilations to the market place has been by the publication and marketing of handbooks. Such handbooks have traditionally been published by commercial publishing houses or by specialized subsidiaries. (See Table III).

In such publications, masses of data covering a broad scientific or technical discipline are compiled and arranged in an accessible form for the user. The compilation is then published in book form [5]. By including within the one publication many sets of data which cover a broad spectrum of users, the publication has broad market appeal.

The data in many cases represent standard values having a useful life-time (to the user) of several years. Thus a specific edition is not immediately outdated on publication, and by bringing out new editions every 2 or 3 years, the publisher sustains a continuous impact on the market.

TABLE III

Examples of User-Oriented Data Products and Services

Item	Characteristic	Example	Traditional Publisher
1. Handbooks	Compilation of Data in Broad Scientific Discipline Published in Book Form	Handbook of Chemistry & Physics	Commercial
2. Data Subscription Services	Initial Set of Data Followed by Updates	1. F & S Index of Corp. & Ind. Monthly 2. GE Data Books on Heat Transfer and Fluid Flow	Commercial
3. Individual Compilations	Determined by Data, Author, Institution, Publisher	NBS Report of Superconductive Materials	Government, Society, Commercial
4. Specialized Compilations	Proprietary or Otherwise Restricted	GE Eng. Mat. & Process Info. Service	Commercial
5. Data Bases of Literature	Secondary Services on Computer Tape	SPIN, CAS, and Commercial Services	Society and Commercial

b. Data Subscription Services

Over the last decade, specialized data services have been developed and marketed on a direct subscription basis. Included in this category are services for which the user receives an initial set of data followed by up-dating revisions or extensions on a pre-arranged periodic basis. From time to time a new up-to-date comprehensive data base is issued which supersedes all earlier editions. Such a service is attractive to the user whenever the data values change with time or in time and where the market places a premium on up-to-date validated data values.

One major segment of data services of this type cover economic or technical-economic fields where new data values become available at fixed calendar dates. For such services, quarterly, semiannual, or annual data values are important to users. Reference 6 is a typical example.

In most technical fields, data values do not become outdated or superseded quite so fast so that periodic updates, where they occur, are much less frequent. One example is the recently introduced series of data books on heat transfer and fluid flow each of which is marketed on a subscription basis [7]. With each service there is an annual up-dating of the data included in the subscription price. This annual up-dating includes the addition of new sections as well as the revision of existing sections.

A more recent development of such data services has been the provision of the data to the user in a computer accessible form. This may be either by the provision of data on a computer magnetic tape or by a computer accessible data service. For the magnetic tapes, the subscription covers periodic updates or supplements, and with many services of this type there are specific computer programs available or provisions for user education and training. In the case of the computer-accessible form of service, the

cost may be made up of a fixed subscription plus a variable amount based on monthly access usage of the data base. An example of this type of data base is one on organic chemical compounds [8]. Data is supplied to the user either on magnetic tape for in-house manipulation or the opportunity is available to use the data base via a remote access computer terminal.

The principal problems involved in marketing data subscription services involve the identification both of potential users and also of the most effective channels to make the availability of the service known. In addition to the ultimate users of these data (scientists and engineers), there are related services (libraries, information centers, and computer centers) whose personnel also have interests as intermediate handlers of the information. Marketing techniques, therefore, involve brochures, mailings, and advertisements, and in the case of computerized services, may also include demonstrations and exhibits at scientific and professional meetings, one and two-day invitational demonstration and training institutes, and on-site demonstrations and trials.

c. Individual Compilations

In many instances, a specific compilation of data is published by itself. The form of product depe is on the scope of the data, its author or editor, the sponsoring institution, and the characteristics of the user group for which it is intended.

Examples can be cited where the finished product is of size and of such broad market impact that a recognized publishing house will publish the compilation in book form [9]. In other instances the compilation is more appropriately published through the sponsoring agency as a monograph [10]. Recently, specialized compilations of data have become available on magnetic tape [11].

In this type of individual compilation, the compiler of the data is very often aware, professionally of the principal generators of the data and in many instances they, in turn, are aware of the compiler's assignment and responsibility [12]. In fact, the compiler or editor has a professional responsibility to evaluate and select the data prior to incorporating it in a publishable data base. The result is that the editor or compiler performs a gate-keeping or quality control function on data values which, to a large extent, become accepted in the profession [13].

The difficulties associated with the marketing of such data bases arise from delineating all potential users other than those who are data generators themselves. As we have indicated, the latter group are known professionally to the compiler, and communications arising during the compilation and interpretation process often occur directly. Identification of other potential users is less straightforward. While one can list general disciplines or sub-disciplines that should be concerned with the data, the specific identification of individuals in colleges, industrial laboratories, or government agencies, who would or should have a direct interest, is very difficult. Thus a major marketing effort is required to attract the attention of these potential users to the availability of the compilation.

Many times in the past, when the sponsor for the compilation of the data has been a Federal department or agency, then the publication and marketing activities have occurred through the Government Printing Office and the Office of the Superintendent of Documents. It is now clear that potential users have not always been aware of the availability of such publications, since they personally may not be exposed to the GPO document listing, and they may not always have local librarians or other information center personnel aware of their specific data interests.

To overcome such gaps in coverage requires such things as advertising in professional journals, direct mailing to university departments or to companies in specific industry classifications and, whenever possible, secondary advertising through newsletters, etc. All these methods will be recognized as inherently inefficient since they employ broadcast techniques to communicate with a narrow interest group.

An alternative marketing approach is to seek to develop on an individual basis a list of names of the potential users for each data base. Hopefully, this list grows as the data base itself becomes more complete and comprehensive. Direct advertising to these users then becomes a more efficient marketing technique, though it may miss many potential users of the data.

A recent challenge, particularly for Federal agency sponsorship of such compilation and evaluation activities, is for the sponsor to demonstrate the broad social value of such data compilations by market place criteria. In particular, if the data compilation and evaluation functions are recognized as research and development activities to be Federally sponsored, as such, then the utility of their output should be evaluated by the extent to which they satisfy a significant segment of the recognized potential market at a price level which covers at least the marketing and distribution costs.

This latter is, of course, most easily recognized when a commercial publisher is willing to serve as the publishing channel. This has recently happened with the multi-volume compilation, "Thermo-physical properties of matter - The TPRC Data Series," in process of being published [14].

d. Other Specialized Compilations

There are certain data compilations in existence for which the distinguishing characteristic is that they are considered highly proprietary

or otherwise restricted by security to a particular company or organization. Almost by definition, such compilations are not for sale or release to the public or to others on an individual basis except by specific authority. Marketing problems are at a minimum. However, consideration is occasionally given to making such compilations accessible to a wider public. Dominant factors in the consideration are the identification of the market for the data and recognition of the marketing channels through which to contact such groups.

For example, compilations of preferred design data on materials are created in many engineering design organizations in industry. Once created, the question is occasionally asked as to whether such an information base would not be saleable especially to manufacturers in related industries. Usually the answer is that such information is too sensitive for proprietary reasons to release. Occasionally the decision is made to offer such a system for sale. In that case, the marketing challenge becomes one of identifying corresponding industrial users and establishing contact channels.

One such example of this type of data base is the Engineering Materials and Processes Information Service (EMPIS)[15]. This is an extensive information bank covering descriptive data and specifications for manufacturing materials. The service was test marketed for three years, but is not presently offered outside the company producing it, though it continues to be an internal system within that company for material specifications. One of the peculiar marketing problems encountered in the test marketing of EMPIS concerned the inability of the potential users of such information (design engineers) to convince appropriate top management that the subscription cost of the service was a necessary expense.

e. Data Bases Covering Scientific and Technical Literature

A recent report [16] has presented the results of a survey of commercially available computer magnetic tape services which can provide libraries and information analysis centers with data bases of scientific and technical literature. This directory lists the general characteristics of each data base, the most frequently used access points, the frequency of the tape issues, and the number of items reported on an average tape issue.

This particular report is the result of cooperation by a special interest group of a scientific society--the American Society for Information Science and the American Institute of Physics. It is to be anticipated that similar compilations of available data bases in other areas will become available through journal articles and other media.

User Access to Data Compilations: The Test of Successful User-Orientation

In the traditional printed form, a data compilation is immediately accessible to the user once he has located the volume either on his own bookself or in the library. The existence of xerographic copying has further reduced any tedium that there may have been in transfering specific data values to his personal information files. As the volume of primary research information has grown, most scientists have been forced into a mode of selectivity of exposure to the literature resulting in a decrease in awareness of pertinent information. This the Weinberg panel foresaw and postulated the development of intermediate information centers for subgroups of users.

In the long-range plan [17] for an information system for physicists, this type of center was envisaged as an integrated information control center. Its major function would be to monitor the interests of user groups in subdisciplines and interdisciplinary combinations relating to physics and astronomy, and to devise and operate procedures for manipulating its files

to provide references and back-up documents for dissemination to users. When one adds the function of information analysis, the generation and publication of topical status reports and annotated bibliographies to supplement conference proceedings, the center expands beyond the concept of a conventional library or information store to a technical information institute which would attract consultant scientists and visiting scholars to engage in the preparation of reviews and compilations.

If one can forecast the effects of further significant decreases in the costs of information transfer through present day land-line or microwave communication channels, augmented by communication satellites and cable T.V., one can speculate that there will develop a close, direct relationship between the user and his particular information analysis center, regardless of geographic distance.

It is the direct user interface which is most crucial to the effective working of information transfer systems and it is one where our efforts to date have made little headway. In most instances, the user now, in answer to this query for some factual data, is invariably given a series of detailed sign-post instructions to original papers. Copies of the papers are not attached and his library is invariably some distance away. Consequently he loses enthusiasm for schemes which tell him how well the primary generators are doing, while he must still hope that his problems will not be forgotten.

Information in the public domain will need to be made more accessible to user enquiry. There are many ways of key-word indexing, subject identifiers, machine methods of self-indexing all directed toward more rapid query access. This the user is coming to expect though he may require considerable education regarding the price level at which such service can be offered.

Another area of direct concern to the user is the collection, organization, and dissemination of data within his own research environment, whether that be a research institute, commercial company, or government agency. Convenient methods of standardized data collection are required with corresponding convenient access methods for co-workers with related interests. Many fields of research now appear to have reached the point where organized data stores would enable researchers to expand the scope of their own research studies with little increase in cost, and, thereby, increase their research productivity.

These are problems that information analysis centers and others who seek to participate in this new industry must address themselves to if they are to retain the interest and support of the user. We are convinced that these centers will be able to solve these problems and to fulfill the need for evaluated data and knowledge compilations. The Weinberg panel should be credited with being a major force in encouraging the appropriate development of centers. They pointed the way toward avoiding, in the future, the stifling effects of the avalanche of information on individual research workers.

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